A PROVINCIAL IMPACT ESTIMATION PROCEDURE FOR THE BRITISH COLUMBIA FOREST SECTOR

Staff Discussion Paper

Garry Horne
David Riley
Lisa Ransom
Stephen Kosempel

Analysis and Evaluation Branch
Treasury Board Staff
Ministry of Finance and Corporate Relations

February 1996

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PREFACE

A Provincial Impact Estimation Procedure for the British Columbia Forest Sector was prepared to provide economists in the province of British Columbia with information and procedures to estimate the provincial economic impact of changes in forest sector activity.

It is intended as an aid to discussions concerning land use planning and related issues. The views expressed in this report are those of the authors and do not necessarily reflect government policy.

This work was supported in part by funds supplied by CRII, the Corporate Resources Inventory initiative, of the Province of British Columbia, and in part by the British Columbia Ministry of Forests.

An early draft of this report was reviewed by economists in the Ministry of Forests, the Ministry of Employment and Investment, and colleagues in Treasury Board Staff. Their comments and suggestions have been incorporated into this document, and we thank them for their input. We are also indebted to Price Waterhouse who shared with us detailed results from some of their surveys of the B.C. forest sector. However, any errors, confusion or other short-comings which remain are the sole responsibilities of the authors.

Your input is welcomed. Please convey your comments, criticisms, and suggestions to :

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EXECUTIVE SUMMARY

A PROVINCIAL IMPACT ESTIMATION PROCEDURE FOR THE BRITISH COLUMBIA FOREST SECTOR

Present day evaluations of forest land management strategies require the estimation of all economic impacts. In addition to the employment and income impacts associated with a change in the forest sector itself (direct impacts), the severity of those impacts are compounded by their effects on transportation, wholesale trade, machine shop repair services, and other business suppliers dependent on expenditures made by the forest sector (indirect impacts), and the consumer goods and services sector which depends on all affected workers spending their disposable incomes (induced impacts). This report presents procedures for the calculation of indirect and induced employment and income impacts for the entire province of British Columbia arising from policy or market produced changes in direct forest sector activity.

Some features of the report include:

- a table displaying historical and regional data on employment, wages, expenditures and sales of the forest sector. The table is intended to assist the economist in the estimation of the direct impacts of proposed changes in forest sector activity when case-specific information is not available.

- a disaggregation of the forest industry by sector. The entire forest sector is defined in this report as encompassing logging and forestry services, lumber, plywood and veneer, pulp, and newsprint. Other wood and paper production activities are assumed to have characteristics similar to lumber and to newsprint respectively.

- the application of the British Columbia Input Output Model (BCIOM) to identify indirect and induced impacts of changes in forest sector activity. The BCIOM is a detailed set of industry and commodity accounting data describing the flow of goods and services between sectors of the B.C. economy.

- a number of tables displaying the indirect and induced impacts associated with direct changes in logging and each manufacturing sector. Specifically, the tables indicate separately the impacts of fibre hauling to processing facilities, non-fibre purchases, the distribution of final products, and direct wage payments to forest sector employees*. Combined, the tables provide estimates of the total impact of most proposed changes in forest sector activity, and also isolate the

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* Although activities related to fibre hauling, the transportation of final products, wholesale trade, and marketing are often performed by the forest sector itself, those services are also sometimes contracted to independent companies. Therefore, they are considered in the report as activities which support the forest sector rather than as a direct part of that sector.

specific impacts on other sectors of the economy which depend on expenditures made by the forest sector.

- procedures for estimating the impacts associated with changes in forest sector investment, and for modifying the impacts resulting from changes in forest sector activity to reflect the influence of the social safety net.

- a number of examples which help illustrate the application of the tables. The examples are in reference to situations encountered typically by economists performing socio-economic impact assessments for timber supply analyses or land use planning processes. Most of the examples used estimate the impacts of reductions in timber harvest levels. However, the procedures developed in this report can also be used to provide estimates of the impacts of expansion of the forest sector (e.g. the opening of a new sawmill) or re-allocation of fibre from one sector to another.

Major findings of the report are summarized as follows:

- The analysis of the forest sector's direct impacts demonstrates significant variations in expenditure patterns between Coast and Interior operations. This finding suggests that different provincial employment or income multipliers may be appropriate in particular applications, except when the case under study is, in fact, characteristic of the province-wide situation[**].

- Significant differences exist in the characteristics and input requirements of each sector of the forest industry. For example, the indirect and induced impacts on fibre hauling activities associated with a $1 million change in fibre expenditure are greater for pulp mills than for sawmills. Since most proposed changes will not impact all sectors of the forest industry, a single multiplier, based on industry-wide averages, will not provide the best estimate in every situation. Our disaggregation of the industry is intended to provide estimates that meet the specific needs of each study.

- No single multiplier will provide the most precise estimate in each specific case. Nonetheless, employment and income multipliers for British Columbia and its Coast and Interior regions are provided for the years 1989 to 1993. The findings of this report indicate that the employment and income multipliers for the entire forest sector fall typically within the range 2.1-2.4 and 1.7-2.0 respectively. If point estimates are required, an employment multiplier of 2.25 and an income multiplier of 1.86 are our best estimates of the most appropriate values.

** Forest sector multipliers are essentially ratios of the estimated total economic activity in the economy generated by direct activity in the forest sector.

This report differs from other studies of the economic impacts of the forest sector in a number of important ways:

- In addition to providing employment and income multipliers for the forest sector, this report includes a procedure for the calculation of case-specific multipliers.

- The impacts identified in this report are lower than suggested in other studies of British Columbia forest sector impacts, and demonstrate that the widely-used forest sector employment multiplier of 3.0 will overstate the impact of changes in forest sector activity.

In conclusion, the impacts estimated by the procedures developed in this report may be lower than those proposed in other studies. Nonetheless, the report provides reasonable and defensible estimates of the impacts associated with policy or market induced changes in forest sector activity, and contains a level of detail that is not found in any other economic impact study of the forest sector. The primary application of the procedures is expected to be in provincial timber supply analyses and analysis of land use decisions in other areas such as the land use planning processes, Aboriginal land claims, and protected area strategies, or for examining the impacts of any other shock which influences the demand for, or supply of, B.C. forest products.

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A PROVINCIAL IMPACT ESTIMATION PROCEDURE FOR THE BRITISH COLUMBIA FOREST SECTOR

I. INTRODUCTION

A consistent procedure for estimating indirect and induced employment and income impacts is required by economists using the multiple accounts guidelines set out in the *Social and Economic Impact Assessment of Forest Land Management Options in British Columbia* for planning the use of provincial forest lands. These guidelines establish regional and provincial evaluation accounts, including a provincial economic development account. This account requires estimates of the impacts of proposed policy changes within a region on provincial employment and income levels resulting from direct linkages to the resources within a region, as well as indirect and induced effects.

One component of provincial economic impact analysis of the forest sector is the estimation of changes in employment and incomes that are likely to result in the entire province, and across all sectors of the provincial economy from a policy or market induced change which affects the forest sector. That is, the economist needs to determine how many jobs and how much personal income may be lost (or gained) as a result of direct changes in the activities of the forest sector. Economic multipliers are one means to estimate these impacts. Forest sector multipliers are essentially ratios of the estimated total economic activity and employment in the economy generated by direct activity and employment in the forest sector.[1] As will become clear in the discussion which follows, a single generic economic impact ratio for estimating provincial level impacts caused by changes in the forest sector will not provide the most accurate estimate in every situation because the direct impacts are usually different from the industry averages used in deriving the multiplier. In addition to providing a single "provincial forest sector multiplier" therefore, this report provides a guide for economists to develop employment and income ratios which may better meet the specific needs of their studies.

When preparing an economic impact analysis, the economist has a choice between picking a multiplier "off the shelf" from a previous study, or calculating a ratio tailored specifically to meet the requirements of the research. For economists who want an "off the shelf" multiplier, the problem then becomes which multiplier estimate to use. In one of the earliest economic impact analyses of the provincial forest sector, F.L.C. Reed and Associates (1973) prepared a report for the British

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[1] Total impacts are composed of direct, indirect and induced impacts. Direct impacts refer to changes in employment and output in the forest sector itself. Indirect impacts refer to changes in transportation, wholesale trade, machine shop repair services, and other business suppliers dependent on expenditures made by the forest sector. Induced impacts result from workers directly and indirectly employed by the forest sector spending their disposable incomes purchasing consumer goods and services.

Columbia Forest Service which provided an employment multiplier for the British Columbia forest industry of 3.0. That is, for every job created (or lost) in the forest industry, two additional jobs would be expected to be created (or lost) in other industries. This ratio became a widely used rule of thumb for estimating employment impacts caused by changes in the forest industry. Over the following twenty years, other economists have used different techniques, and updated data to create new (and different) employment multipliers[2]. Because each study used different theoretical approaches, definitions, and data bases, and calculated results for different time periods, it is not surprising that they resulted in different multiplier estimates. This myriad of multipliers has, however, created confusion both for economists assessing the potential employment impacts of policy or market changes affecting the forest industry, and for the end users of published studies who must reconcile the different results which arise when different multipliers are chosen.

Rather than simply developing a single all-purpose multiplier, in this paper we are proposing a procedure which an economist can follow to arrive at defensible estimates of the economic impacts of any proposed change in forest sector activity.

In this report, we separate the economic impact estimation problem into two distinct parts: (1) the case-specific estimates of direct (forest sector) spending changes which result from the original change; and (2) the use of these values to estimate indirect and induced impacts outside the forest sector. Diagram 1 on the following page clarifies this process.

The first part of this two part procedure is the responsibility of the economist who must focus in on the situation under study and estimate the most appropriate values. In Chapter II, we provide some statistics which may assist in this part of the procedure if the economist does not have the necessary information. However, as will be seen, these same statistics indicate how much variation is possible at this stage, and why it is therefore incumbent on the economist to make use of case-specific estimates wherever possible.

For the second part of the procedure we provide impact estimate tables developed using the B.C. Input Output Model (BCIOM). This model has been widely used to estimate the provincial economic impacts of many provincial programs and projects over the last ten years. We have used it here to provide estimates of the impacts on provincial employment and incomes for each of the identified components of forest industry spending. A detailed description of the BCIOM and its underlying assumptions is provided in Appendix C.

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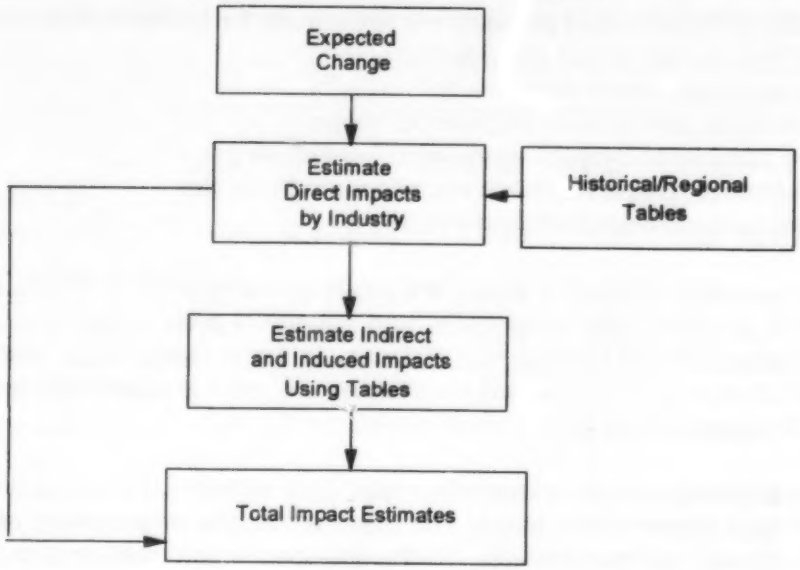
[2] Some examples include studies by Romain Jacques (1988), the Ministry of Finance (1991), and David Park (1994).

Diagram 1
Procedure for Estimating Economic Impacts



This paper begins with a chapter on the estimation of direct impacts. As noted above, this is the responsibility of the economist. However, the material in this chapter has been compiled to assist the economist, if such help is required. Chapter III then provides and discusses the provincial impact estimate tables referred to above. Example applications are illustrated in Chapter IV. Some other impacts and possible modifications to the tables are discussed in Chapter V. A few concluding remarks are provided in Chapter VI. Technical background documentation is found in the Appendices.

In this report, we consider the British Columbia forest sector to be comprised of five subsectors: logging and forestry (including silviculture and forest services), lumber (sawmills), plywood and veneer, pulp, and newsprint. Many previous studies have treated the entire forest sector as a single industry, so our disaggregation of the analysis represents a significant improvement which recognizes the different characteristics and requirements of each subsector. Nevertheless, there may appear to be parts of the forest sector which have been omitted from our approach. These include wood remanufacturing and paper products other than newsprint. The other wood and paper products manufacturing operations are assumed to have characteristics similar to lumber (in the case of wood) and to newsprint (in the case of paper). In addition, the Ministry of Forests is not included as a component of the forest industry, since its activities are normally unaffected by changes in timber harvest and/or processing levels.

II. ESTIMATING DIRECT IMPACTS

The first step of the proposed procedure is to estimate the following direct economic impacts of the change under consideration:

1. Employment in each direct sector
2. Total wage payments in each direct sector
3. Fibre purchases by each manufacturing industry
4. Non-fibre purchases by each manufacturing industry
5. Sales by each manufacturing industry

The direct sectors referred to above are logging and forestry services, sawmills, veneer and plywood mills, pulp mills, and newsprint mills. The manufacturing industries referred to are the final four of these. In many cases under study, not all of the manufacturing industries will be affected; i.e. zero is a perfectly good direct estimate for some industries for some cases.

In addition to the above necessary information, the economist should consider the hauling of fibre between industries, and the costs and/or employment associated with the distribution of final products. Such case-specific information should always be incorporated into the analysis as much as possible. How to do this, for at least some cases, is discussed in Chapter III and illustrated by examples in Chapter IV.

If the economist has all of the information stipulated above, he or she is ready to proceed with the estimation of indirect and induced impacts, the procedures for which are discussed in detail in Chapter III. The remainder of this chapter is intended to provide historical and regional information which will assist the economist to make reasonable estimates of direct impacts in situations where case-specific information is not readily available. A secondary reason for the remainder of this chapter is to indicate the kind and magnitude of variations in expenditure patterns which can arise.

Table 1 displays estimates of direct impacts per thousand cubic metres of fibre, harvested in the case of logging or processed in the case of the manufacturing sectors. These estimates are derived from information in five Price Waterhouse annual reports of the B.C. forest sector (1989 to 1993 inclusive). For each case, we present the 1993 value, the range of values over the five years, and the mean value over the same five years. The range gives an indication of how much variation there is in the estimate, and the five-year average (in constant 1992 dollars, to remove the effects of inflation) may provide a reasonable estimate to use which avoids the extremes. Where the information permits, we have provided separate figures for Coast and Interior operations.

Table 1

Direct Impacts by Sector per Thousand Cubic Metres of Fibre Harvested, in the Case of Logging, or Processed, in the Case of Manufacturing Sectors

	Coast			Interior		
	1993	5 Year Range	5 Year Average	1993	5 Year Range	5 Year Average
Logging*						
Employment (jobs)	0.44	0.44-0.48	0.45	0.28	0.26-0.28	0.27
(1992 $ 000s)						
Total Wages	22.5	22.4-24.8	23.5	15.8	15.2-17.3	15.9
Non-fibre Purchases	24.6	22.4-24.6	23.3	16.5	12.7-16.9	15.2
Lumber/Sawmills						
Employment (jobs)	0.57	0.57-0.66	0.62	0.33	0.33-0.36	0.34
(1992 $ 000s)						
Total Wages	22.7	21.8-25.9	23.8	13.2	12.9-15.0	13.9
Fibre Purchases	99.3	70.0-99.3	79.2	45.2	40.8-45.2	42.3
Non-fibre Purchases	21.8	19.5-22.0	20.8	11.6	9.8-11.6	10.6
Sales	159	111-159	126	93	56-93	68
Pulp						
Employment (jobs)	0.40	0.32-0.43	0.39	0.30	0.28-0.31	0.30
(1992 $ 000s)						
Total Wages	16.4	16.1-19.7	17.3	14.9	14.9-16.0	15.4
Fibre Purchases	31.6	30.7-35.4	32.9	23.6	23.6-38.7	30.8
Non-fibre Purchases	37.2	35.8-40.1	38.0	39.1	37.7-46.0	41.7
Sales	76	76-144	106	65	65-163	108
	Plywood - B.C.			**Newsprint - B.C.**		
	1993	5 Year Range	5 Year Average	1993	5 Year Range	5 Year Average
Employment (jobs)	0.80	0.80-1.08	0.97	0.71	0.71-0.92	0.81
(1992 $ 000s)						
Total Wages	29.3	29.3-41.8	35.0	30.1	30.1-37.5	34.8
Fibre Purchases	69.8	59.9-69.9	64.5	51.4	46.5-52.1	49.8
Non-fibre Purchases	26.7	23.5-33.0	27.4	91.1	85.9-98.1	92.9
Sales	157	128-160	142	192	188-223	208

Provincial level results only for plywood and newsprint

* The Price Waterhouse estimate for employment in Interior logging in 1989 has been adjusted to include contractors harvesting under the Small Business Forest Enterprise Program. These contractors are included in subsequent years of Price Waterhouse reports.

The estimates in Table 1 differ from those published by the Economics and Trade Branch of the Ministry of Forests (MoF) which are compiled using harvest data from

the Timber Harvesting Branch and employment data from Statistics Canada's Census of Manufacturers. The differences are due to the different sources of the information and also the different denominators -- in the processing sectors our estimates of employment per thousand cubic metres of fibre refer only to fibre **processed by that sector** whereas the MoF figures relate all estimates to each thousand cubic metres of fibre **harvested**.

Some of the information required by our procedure (e.g. non-fibre purchases) is not available from other sources, so in order to be internally consistent, Table 1 provides consistent estimates for all necessary parameters which can be used in the absence of better information. It should be emphasized, however, that the information in Table 1 is not essential to the methods proposed in this report, and other estimates of direct impacts may be used.

III. ESTIMATING INDIRECT AND INDUCED IMPACTS

The following sections provide provincial indirect and induced impact estimates resulting from specified direct changes in logging (where appropriate) and each of the wood manufacturing industries[3].

III.1 Fibre Input Costs

The costs associated with the fibre supply itself are covered mainly by recognizing and computing the direct impacts associated with the logging sector. However, as noted earlier, there may be some additional economic activity associated with the movement and distribution of fibre from where it is logged to where it is finally processed. Also, there may be some confusion as to whether this activity is already counted as part of logging or part of milling. Most fibre hauling activities are performed by companies which are not directly involved in the harvesting or manufacturing of fibre. Therefore, we believe that fibre movement and distribution activities should be considered separately whenever possible, and regarded as indirect activities which support the forest sector. The distinction between the group of activities classified as the forest sector (the direct impacts) and the industries which support that sector (the indirect impacts) is clarified further in Appendix B.

Table 2 provides estimates of the indirect and induced fibre hauling impacts associated with $1 million (1992$) of fibre purchase for each of the four forest manufacturing industries. These figures were estimated using the BCIOM. It is emphasized that the impacts estimated in this table are realized in addition to other impacts created from the transportation of manufactured paper and wood products to export markets.

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[3] It is assumed in the estimation of induced impacts that wage earners spend 75 percent of their disposable income (before taxes, excluding benefits) purchasing consumer commodities. The remainder is allocated to taxes, savings and out-of-province expenditures.

Table 2
Impacts of Fibre Hauling to Processing Facilities
Per $ Million (1992) of Industry Expenditure on Fibre

	Jobs				Wages (1992 $000s) (before taxes, excluding benefits)			
	Indirect Transport	Indirect Other	Induced	Total	Indirect Transport	Indirect Other	Induced	Total
Sawmills	0.34	0.13	0.16	0.63	12.7	4.4	4.0	21.1
Plywood Mills	0.41	0.15	0.19	0.75	15.3	5.2	4.9	25.4
Pulp Mills	0.68	0.26	0.31	1.25	25.3	8.7	8.0	42.0
Newsprint Mills	0.52	0.20	0.27	0.99	22.3	7.1	6.9	36.3

Where hauling costs are not included in the cost of fibre purchases, the economist should always use his or her own estimate of fibre hauling jobs if the data is available. This may differ from estimates derived from these tables. If necessary, the indirect and induced jobs and income associated with fibre hauling should be adjusted by assuming that these are proportional to the direct hauling activities and the appropriate linear relationship is provided by the information in the table for each industry.

As an example, suppose we wish to estimate the impacts of transportation to sawmills assuming a fibre loss of three million cubic metres in the interior area. Suppose further that the economist has independently estimated that this will involve an employment loss of 50 truck haulers. It is also assumed that these hauling jobs have not been included in the estimate of direct employment loss.

The expenditure decrease on fibre is estimated to be $127 million (1992$). This estimate is calculated using the five year average of fibre purchases associated with interior sawmills presented in Table 1 (3,000,000 × 0.0423 ÷ 1,000). Using Table 2 coefficients, this implies a loss of 43 indirect transportation jobs (127 × 0.34) and a total loss of 80 jobs (127 × 0.63).

Based on case-specific information the economist has determined that there are 50 indirect hauling job losses. Therefore, the total job loss associated with fibre transport can be estimated by assuming linear proportions. This calculation results in an estimated total employment loss of 93 jobs (50 ÷ 43 × 80). Thus, other indirect and induced employment loss is estimated to be 43 jobs (93 - 50). These 43 jobs represent employment in sectors that are not hauling fibre. Indirect and induced income reductions can be estimated in a similar way.

III.2 Purchase of Non-fibre Goods and Services

These purchases lead to employment and income in other manufacturing sectors and in the service industries (indirect effects), and through personal spending, to economic activity in the consumer goods and services industries (induced effects). The table below provides estimates of these indirect and induced impacts per million dollars of purchases of these commodities by each component of the forest sector.

Table 3
Impacts of Non-fibre Purchases
Per $ Million (1992) of Industry Expenditure on Goods and Services

	Jobs			Wages (1992 $000s) (before taxes, excluding benefits)		
	Indirect	Induced	Total	Indirect	Induced	Total
Logging	8.17	2.57	10.74	283.0	66.9	349.9
Sawmills	7.09	1.97	9.06	217.0	51.2	268.2
Plywood Mills	6.12	1.80	7.92	198.1	46.8	244.9
Pulp Mills	5.80	1.72	7.52	189.4	44.7	234.1
Newsprint Mills	4.84	1.46	6.30	160.6	37.9	198.5

III.3 Distribution of Final Products

These activities relate to additional economic activity which takes place after production is completed: wholesale trade, marketing, and transportation of the finished products from the producer to the final purchaser. Although the forest manufacturers themselves conduct a substantial part of the wholesale trading and marketing functions internally, these services are also performed by independent companies. As such, they are treated as activities which support the forest sector, rather than as a direct part of it. The table below displays, for each of the manufacturing forest product industries, the economic impacts which typically result from each million dollars of sales.

Table 4
Distribution of Final Product - Per $ Million (1992) of Sales

	Jobs			Wages (1992 $000s) (before taxes, excluding benefits)		
	Indirect	Induced	Total	Indirect	Induced	Total
Sawmills	2.03	0.74	2.77	81.5	19.3	100.8
Plywood Mills	1.61	0.58	2.19	64.3	15.2	79.5
Pulp Mills	0.76	0.27	1.03	30.5	7.2	37.7
Newsprint Mills	0.81	0.29	1.10	32.5	7.7	40.2

As in the case of the hauling of fibre to processing plants, there is the possibility that the economist will have some case-specific information about these post-production activities. For example, in some cases the head office of the parent corporation may handle all of these matters directly, and the expected exogenous change would have no impact on the number of staff devoted to the distribution of final products. In such a case, the economist should omit these estimates. In other cases, employment in the distribution of final products may be expected to change following a shock to the forest sector. If case-specific information is available to the economist, that information should always be incorporated into an estimate of the indirect impact of the shock. In this case, the economist should multiply the expected change in jobs devoted to these activities by the appropriate ratio of the total to indirect impacts provided in Table 4.

The data on which the estimates in Table 4 are based was supplied by the Input-Output Division of Statistics Canada. This information represented wholesale and transportation trade margins for Canadian wood and paper products for the year 1987. We have confirmed the order of magnitude of these estimates by reference to information in *The Input-Output Structure of the Canadian Economy, 1990* (Statistics Canada Cat. No. 15-201). To our knowledge, no comparable information exists for British Columbia alone. (Trade and transportation margins for forest products or other commodities are not explicitly identified in the BCIOM database.)

III.4 Wages & Salaries

The impacts associated with direct payment of wages to forest sector employees are comparatively simple because the only economic impacts that occur are due to the personal spending of these incomes. For each one million dollars paid in wages and salaries (before taxes, excluding benefits), the BCIOM estimates (1992) that the following provincial induced impacts occur:

- employment: 9.09 jobs; and
- wages: $236,000.

III.5 Non-wage Benefits

In this study, we have concentrated on impacts in the form of employment and wage incomes and the induced impacts that arise from the spending of wages in the domestic economy. However, for some applications it may be appropriate to express the final impact results in terms of total incomes which include non-wage benefits. To satisfy this requirement, we suggest application of the values in the following table.

Table 5
Non-wage Benefits

	Benefits to Wages Ratio
Forest Sector	0.33
All Indirect Activities	0.10
All Induced Activities	0.07

These are mean values derived from the Price Waterhouse report for the forest sector and from the BCIOM for indirect and induced activities.

IV. APPLICATIONS OF THE PROCEDURE

We are now in a position to be able to illustrate the application of the procedure developed in Chapters II and III with some specific cases. We present three examples which may be situations encountered by economists carrying out socio-economic impact assessments. We then consider an example using the entire B.C. forest sector. Lastly, we provide a summary of annual employment and income ratios for the years 1989-93 for the Coast and Interior regions and the province as a whole. Note that in the examples which follow, we make use of the tabulated values in Chapter III. Appendix D presents the required calculations for any specific case in "spreadsheet format".

IV.1 Interior Logging Example

Suppose there is a change of 100,000 cubic metres in timber harvested in the Interior. Suppose further that it is known that this change will not have any impacts on the processing sectors in the province (for this example, it is assumed that either imports or exports of raw logs will change by an equivalent amount, so the processing sectors will therefore be unaffected by the change in domestic fibre supply).

The economist will need to estimate the following direct impacts: employment, total wages and non-fibre purchases. In the absence of more specific information, we will use the 5 year average values in the table of direct interior logging impacts (Table 1) to provide these estimates. Then:

- direct employment = 100 × 0.27 = 27 jobs
- direct wages = 100 × $15,900 = $1.59 Million
- non-fibre purchases = 100 × $15,200 = $1.52 Million

(a) Non-fibre Purchases

With these values in hand, the indirect and induced impacts can now be estimated using the procedures developed in Chapter III. In particular, by applying the 1.52

to the values in Table 3, the $1.52 million spent on non-fibre supplies and services yields the following estimates:

	Jobs	——$ Millions (1992)—— Wages	Wages & Benefits[4]
Indirect	12.42	.430	0.473
Induced	3.91	.102	0.109
Total	16.33	0.532	0.582

(b) Wages
Similarly, the spending of the $1.52 million in wages leads to the following induced impacts:

	Jobs	——$ Millions (1992)—— Wages	Wages & Benefits
Induced	14.45	0.375	0.401

The total impacts associated with this very simple example then are:

- employment: 27 + 16 + 14 = 57 jobs
- wages: 1.590 + 0.532 + 0.375 = $2.50 Million
- wages & benefits: 2.115 + 0.582 + 0.401 = $3.10 Million

IV.2 Coast Logging Example

The same conditions apply to this example as the previous one, except the timber harvest reduction is in the Coast region. The direct estimates differ because of the change in location. Again, using the average values in Table 1, the direct impacts are estimated to be:

- direct employment = 100 × 0.45 = 45 jobs
- direct wages = 100 × $23,500 = $2.35 Million
- non-fibre purchases = 100 × $23,300 = $2.33 Million

Then indirect and induced impacts are:

	Jobs	——$ Millions (1992)—— Wages	Wages & Benefits
a) Non-fibre Purchases			
Indirect	19.04	0.659	0.725
Induced	5.99	0.156	0.167
Total	25.03	0.815	0.892

[4] The values in this column have been estimated by applying the ratios in Table 5 to the estimates in the wages column.

(b) Wages			
Induced	21.36	0.555	0.594

Thus, the total impacts associated with this change in the Coast harvest level are:

- employment: 45 + 25 + 21 = 91 jobs
- wages: 2.350 + .815 + .555 = $3.72 Million
- wages & benefits: 3.126 + .892 + .594 = $4.61 Million

IV.3 Coast Logging and Lumber Example

Consider now a somewhat more complex example. As above, we assume that the initial change to be analysed is 100,000 cubic metres of timber harvested. However, in this case we also assume that this timber is processed at a local sawmill (if the change is an increase in supply, then the impacts will be positive and we assume that the sawmill can increase its throughput; if the change is negative, we assume that the sawmill throughput will be negatively affected).

We begin the analysis by first estimating the direct impacts. Using the five year averages for coastal operations given in Chapter II yields the following table of direct estimates.

	Logging	Lumber
Employment (jobs)	45	62
Wages ($ Millions 1992)	2.35	2.38
Fibre Purchases ($ Millions 1992)	--	7.92
Non-fibre Purchases ($ Millions 1992)	2.33	2.08
Sales ($ Millions 1992)	--	12.6

Note once again that it is not necessary to use the information in Chapter II to estimate the numbers in the above table. If the economist has this information from other sources which may be more suitable than the regional five year averages, it should be used.

The logging part of this example has already been analysed in Section IV.2, and the total logging impacts are repeated below:

- 91 jobs
- $3.72 Million in wages
- $4.61 Million in wages and benefits

Lumber impacts are shown on the next page.

	Jobs	------$ Millions (1992)------ Wages	Wages & Benefits
(a) Fibre Hauling			
Hauling	2.69	0.101	0.111
Indirect to Hauling	1.03	0.035	0.039
Induced	1.27	0.032	0.034
(b) Non-fibre Purchases			
Indirect	14.75	0.451	0.496
Induced	4.10	0.106	0.113
Total	18.85	0.557	0.609
(c) Distribution of Final Products			
Indirect	25.58	1.027	1.130
Induced	9.32	0.243	0.260
Total	34.90	1.270	1.390
(d) Wages and Salaries			
Induced	21.63	0.562	0.601

Finally, we can collect these estimates by type of impact as shown below

	Logging	Lumber	Total
Employment			
Direct	45	62	107
Indirect	19	44	63
Induced	27	36	63
Total	91	142	233
Wages ($ Millions)			
Direct	2.35	2.38	4.73
Indirect	0.66	1.61	2.27
Induced	0.71	0.94	1.65
Total	3.72	4.93	8.65

Wages & Benefits ($ Millions)			
Direct	3.13	3.17	6.29
Indirect	0.73	1.77	2.50
Induced	0.76	1.01	1.77
Total	4.62	5.95	10.56

IV.4 The Entire Province in 1992

This example considers the entire B.C. forest sector. The determination of the fundamental data inputs and the results of the impact estimation procedure are described in some detail below. It is important, however, to emphasize that the "multiplier" derived from this work has validity limited to some specific cases. It is an appropriate answer to the question, "What is the average provincial economic impact associated with the loss or gain of one job in the forest sector, when we don't know where in the province that job is, or in which particular sub-sector?" It is unlikely to provide the best estimate in any specific case. Nevertheless, it may be of interest for comparison with the work of Reed discussed earlier.

There are a number of possible data sources which provide information on the direct impacts of the forest sector. Some of these sources include the Price Waterhouse reports of the forest sector, Labour Force Survey (LFS), Annual Survey of Manufacturers (AS), and Survey of Employment, Payroll and Hours (SEPH). However, the estimates suggested by those sources are conflicting. In the example which follows we have elected to rely on information from the 1993 Price Waterhouse report[5]. This report provides a comprehensive picture of the forest sector in B.C., and we are confident that the estimates are reliable. Table 6 on the next page displays the direct impact estimates required as inputs for this example.

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[5] Price Waterhouse, *The Forest Industry in British Columbia, 1992 Report Tables*, May 1993.

Table 6
Direct Impacts for B.C. 1992

		------$ Millions (1992)------			
	Employment (jobs)[6]	Wages	Fibre Purchases	Non-fibre Purchases	Sales
Logging and Forestry	25,050	1,351	--	1,221	--
Lumber	24,450	935	3,033	793	4,986
Plywood	3,200	115	229	90	501
Pulp	7,950	348	603	835	1,877
Newsprint	4,600	174	235	488	928
Total[7]	**65,250**	**2,923**	**4,100**	**3,427**	**8,292**

[6] These employment estimates are also taken from the Price Waterhouse report. Note that they differ from job estimates derived from other sources (e.g. LFS, AS, SEPH). The apparent discrepancy reflects primarily our exclusion of some wood and paper production activities. Total employment in the forest sector in 1992, including all wood and paper production activities, is estimated by Price Waterhouse at 87,700.

[7] Excludes wood remanufacturing, paper products other than newsprint, and the Ministry of Forests.

Table 7
Employment Impacts by Industry 1992

	Jobs			
	Direct[8]	Indirect	Induced	Total
Logging and Forestry	25,050	--	--	
Wages	--	--	12,281	
Non-fibre Purchases	--	9,976	3,138	
Sub-Total	**25,050**	**9,976**	**15,419**	**50,445**
Lumber	24,450	--	--	
Wages	--	--	8,499	
Fibre Hauling	--	1,426	480	
Non-fibre Purchases	--	5,622	1,562	
Product Distribution	--	10,122	3,690	
Sub-Total	**24,450**	**17,170**	**14,231**	**55,851**
Plywood	3,200	--	--	
Wages	--	--	1,045	
Fibre Hauling	--	128	44	
Non-fibre Purchases	--	551	162	
Product Distribution	--	807	291	
Sub-Total	**3,200**	**1,486**	**1,542**	**6,228**
Pulp	7,950	--	--	
Wages	--	--	3,163	
Fibre Hauling	--	567	187	
Non-fibre Purchases	--	4,843	1,436	
Product Distribution	--	1,427	507	
Sub-Total	**7,950**	**6,837**	**5,293**	**20,080**
Newsprint	4,600	--	--	
Wages	--	--	1,582	
Fibre Hauling	--	169	63	
Non-fibre Purchases	--	2,362	712	
Product Distribution	--	752	269	
Sub-Total	**4,600**	**3,283**	**2,626**	**10,509**
Total	**65,250**	**38,752**	**39,111**	**143,113**

As for the previous examples, every expenditure component of every sub-sector will generate its own impacts as shown in Table 7 above. These calculations lead to a total employment multiplier of 2.19 since:

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[8] Excludes wood remanufacturing, paper products other than newsprint, and the Ministry of Forests.

$$\frac{(50,445+55,851+6,228+20,080+10,509)}{(25,050+24,450+3,200+7,950+4,600)} = \frac{143,113}{65,250} = 2.19$$

In other words, each direct job generates an additional 1.19 jobs.

Table 8
Income Impacts by Industry 1992

	------ Wages $ Millions (1992)------			
	Direct[9]	Indirect	Induced	Total
Logging and Forestry	1,351	--	--	
Wages		--	318.84	
Non-fibre Purchases		345.54	81.68	
Total	1,351	345.54	400.52	2,097.06
Lumber	935	--	--	
Wages		--	220.66	
Fibre Hauling		51.87	12.13	
Non-fibre Purchases		172.08	40.60	
Product Distribution		406.36	96.23	
Total	935	630.31	369.62	1,934.93
Plywood	115	--	--	
Wages		--	27.14	
Fibre Hauling		4.69	1.12	
Non-fibre Purchases		17.83	4.21	
Product Distribution		32.21	7.62	
Total	115	54.73	40.09	209.82
Pulp	348	--	--	
Wages		--	82.13	
Fibre Hauling		20.51	1.83	
Non-fibre Purchases		158.15	37.32	
Product Distribution		57.25	13.51	
Total	348	235.91	134.79	718.70
Newsprint	174	--	--	
Wages		--	41.06	
Fibre Hauling		6.91	1.62	
Non-fibre Purchases		78.37	18.50	
Product Distribution		30.16	7.15	
Total	174	115.44	68.33	357.77
Total	**2,923**	**1,381.93**	**1,013.35**	**5,318.28**

[9] Excludes wood remanufacturing, paper products other than newsprint, and the Ministry of Forests.

Total income impacts can be estimated similarly. The results are displayed in Table 8. The income multiplier is:

$$\frac{(2,097+1,935+210+719+358)}{(1,351+935+115+348+174)} = \frac{5,318}{2,923} = 1.82$$

IV.5 Employment and Income Ratios, 1989-1993

Using direct information from the Price Waterhouse reports for the years 1989 to 1993, the procedures and coefficients of Chapter III, and a spread sheet program to expedite the calculations, employment and income ratios have been calculated for the entire province, and for the Coast and Interior regions. These ratios by sector are displayed in Table 9 and reflect the average of the values estimated over the five year period. The values in Table 10, on the other hand, specify the ratios for the entire forest industry and are provided for each of the five years.

The employment and income ratios displayed in these tables are calculated primarily to indicate the range of values possible and to provide another justification for recommending case-specific calculations. However, in recognition of possible constraints on time, cost and availability of information, which may limit the use of the tables in Chapter III, these ratios provide the best alternative to case-specific estimates.

Table 9
Employment and Income Ratios by Major Region and Sector

	Coast		Interior		Province	
	Job Ratio	Wage Ratio	Job Ratio	Wage Ratio	Job Ratio	Wage Ratio
Logging*	2.02	1.58	2.14	1.61	2.08	1.59
Lumber	2.31	2.08	2.29	2.00	2.29	2.03
Plywood	N.A.	N.A.	N.A.	N.A.	1.93	1.81
Pulp	2.54	2.05	3.02	2.20	2.74	2.12
Newsprint	N.A.	N.A.	N.A.	N.A.	2.46	2.06

* The Price Waterhouse estimate for employment in Interior logging in 1989 has been adjusted to include contractors harvesting under the Small Business Forest Enterprise program. These contractors are included in subsequent years of Price Waterhouse reports.

Table 10
Forest Sector Employment and Income Ratios by Major Region and Year[10]

	Coast		Interior		Province	
	Job Ratio	Wage Ratio	Job Ratio	Wage Ratio	Job Ratio	Wage Ratio
1989[10]	2.29	1.82	2.35	1.92	2.32	1.86
1990	2.23	1.83	2.27	1.80	2.25	1.80
1991	2.14	1.82	2.17	1.75	2.15	1.79
1992	2.19	1.87	2.20	1.76	2.19	1.82
1993	2.35	1.94	2.36	1.90	2.35	1.90
Average	2.24	1.86	2.27	1.83	2.25	1.83

* The Price Waterhouse estimate for employment in Interior logging in 1989 has been adjusted to include contractors harvesting under the Small Business Forest Enterprise program. These contractors are included in subsequent years of Price Waterhouse reports.

V. SOME ADDITIONAL IMPACTS AND POSSIBLE MODIFICATIONS

The procedure for the estimation of direct and subsequent indirect and induced impacts of a change in forest sector activity does not incorporate industry investment as a variable, nor does it consider the influence of the social safety net on actual economic impacts. Specifically, it has been assumed that the amount of investment is independent of small changes in the level of cut, and that the affected individuals move in and out of the provincial economy instantaneously to maintain full employment. These assumptions and some other impacts of the forest sector which may appear to have been ignored are discussed below.

V.1 Estimating the Impacts of Forest Sector Investment

Besides the indirect and induced impacts due to forest sector operations, circumstances may require the analyst to consider impacts arising from a change in forest sector investment in plant and/or machinery and equipment.

For the purposes of this study, we have chosen to separately analyse the impacts associated with investment. As a result, these effects are not included in the

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[10] In the Coast and Interior regions in Table 10, newsprint operations were assumed to be split 92% Coast and 8% Interior in each of the five years, and to have the same cost structures in each region. Similarly, plywood operations were assumed to be split 28% Coast and 72% Interior throughout the 1989-93 period.

multipliers displayed in Tables 9 and 10. Those multipliers have been estimated to reflect the effects associated with a change in the current level of operation.

Our reasoning is that the decision to invest is not solely related to those current operations. Investment decisions are complex and difficult to model and forecast. These decisions are contingent on many factors, including current capital, capacity, the age of this capital, past and present operations, the relative cost of labour versus capital and perhaps most importantly, the owners' expectations of future conditions and opportunities.

Notwithstanding these reservations, the BCIOM can be used to estimate the impacts due to a one million dollar investment in plant or machinery and equipment.

Impacts due to investment in any one year are typically short term. That is, construction jobs for new plant or employment arising from installing new equipment do not represent ongoing economic activity. However, suppose that the forest sector *"typically"* hopes to invest on average $x million per year but due to a change in forest sector opportunities (e.g. land use allocation), decides to invest $y million per year. This change in annual expenditures may result in reduced economic activity. To add the impacts due to operations with the impacts due to investment, the analyst needs to estimate lost annual investment expenditure which, in this example, is an average annual loss of $(x-y) million.

Another difficulty with respect to investment is ascertaining future employment impacts arising from the annual $y million of investment that does occur. Presumably some of this investment entails new machinery and equipment acquisition which may result in increased labour productivity which in turn may reduce employment in the forest sector. As a further complication, this could have the effect of increasing the indirect employment coefficients per million dollars of operational activity within the forest sector. It is because of such uncertainties that this study has not included investment considerations in its detailed multiplier calculations.

Table 11 shows the 1992 income (before taxes, excluding benefits) and the 1992 employment impacts due to a one million dollar investment expenditure. These impacts are displayed separately for the two main types of investment (plant construction and machinery and equipment) for each of the three major divisions of the forest sector (logging, wood, paper and allied).

The impacts estimated in Table 11 demonstrate the importance of determining the mix of lost investment activity. For example, a one million dollar investment in machinery and equipment had an estimated impact of roughly 5 jobs in 1992. On the other hand, a one million dollar investment in plant construction resulted in approximately 15 jobs in 1992.

It is incumbent upon the analyst to initially estimate the amount and mix of changed forest sector investment in order to use the associated 1992 coefficients in Table 11. The analyst should also use 1992 constant dollar investment activity or deflate the above employment coefficients for current dollar activities.

Table 11
1992 Employment and Income Impacts by Forest Sector per Million Dollars of Expenditure in Investment (Construction and Machinery & Equipment)

Investment Type and Sector (Per Million Dollars of Expenditure - 1992)	Employment (Jobs)	Income ($1992)
Machinery & Equipment		
Logging	5.3	163,891
Wood Manufactures	4.9	161,876
Paper and Allied Manufactures	5.0	169,086
Construction		
Logging	15.6	550,584
Wood Manufactures	15.3	547,475
Paper and Allied Manufactures	15.1	541,156

Impacts estimated from the BCIOM and include direct, indirect and induced effects.

V.2 The Effect of the Social Safety Net

The BCIOM is a static model. That is, it provides a representation of the economy at a single point in time. The impacts presented in Chapters III and IV are designed to portray the state of the economy after it has adjusted fully to a change in forest sector activity. The procedures provided in this section, on the other hand, will enable the economist to derive estimates of more immediate, or interim, effects of a shock.

In Chapter III it is assumed in the procedure applied to estimate the employment and income impacts that all sectors of the economy are operating at full capacity and never slip into a state of temporary adjustment. In other words, a constant state of equilibrium is maintained in this static model by assuming that changes in the demand for labour are satisfied by instantaneous changes in migration (e.g. a new supply of labour is required to increase output). Although it is possible to relax this assumption, in order to produce equivalent results it must then be assumed that displaced labour has no value outside its current use. From a provincial

perspective neither of these assumptions provide an accurate portrayal of the economy in the very short-run.

For example, suppose the economy is currently in a state of adjustment (i.e. operating at less than full employment) and that unemployed workers are receiving social assistance. Suppose further that there is an exogeneous increase in forest sector activity which leads to an increase in employment. In this case, new jobs are filled by unemployed workers in the province. As a result, the estimated total provincial benefit of this positive shock must be adjusted downward to reflect income the province foregoes (i.e. welfare payments relinquished by newly employed workers). Similarly, the values estimated in this report may overstate the short-term impact of a negative shock, which has the effect of moving the economy into a temporary state of adjustment. In this case, the economic impact of a job loss will be offset by the amount of unemployment insurance, welfare, etc., the unemployed worker is eligible to collect.

Although social assistance programs are sometimes abused, those programs are intended to provide only temporary relief to unemployment. In other words, the social safety net cushions the impact of adjustment, rather than prevents adjustment. This is because UI benefits will expire over time and eventually force the movement of displaced workers out of province in search of employment elsewhere. At this time the economy will have adjusted completely to the shock. In Section III we chose to ignore the time required for these adjustments to occur and proceeded directly to an estimation of the end result.

Generally, the employment and income impacts suggested earlier will provide the best estimates to include in an assessment of a policy proposal. Nonetheless, circumstances may require the economist to estimate the short-term impacts of a proposed change. Tables 12 and 13 below provide a procedure for incorporating the mitigating effects of the social safety net into the estimates derived from the BCIOM in Chapter III. The values displayed in those tables are the ratios of the short-term to long-term impacts. These values (or adjustment factors) can be used to calculate the short-term impact of changes in forest sector activity as follows:

Short-term Impact = Long-term Impact * Adjustment Factor. (1)

The adjustment factors are based on 75 percent recycling of wages, 85 percent recycling of UI benefits[11], and the fact that workers are eligible to claim 55 percent of their insurable earnings to a maximum of $448 per week. Using Price Waterhouse employment and wage statistics for 1992, it has been determined that the cap on UI benefits is relevant only for workers employed in the logging and pulp sectors.

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[11] Since personal income taxes, savings, and out-of-province expenditures are positively correlated with income level, the percentage of income which creates spin-off activity will be smaller for wage earners than for UI recipients.

Notice that the adjustment factors on all direct and indirect jobs are equal to one. This is because the social safety net does not prevent unemployment in those sectors. However, it does reduce the provincial impact of a change in employment. Since UI benefits provide some income compensation for unemployed workers, induced job impacts are less severe in the short-term.

Table 12
Adjustment Factors for the Estimation of Short-term Direct and Induced Impacts Resulting From Changes in Forest Sector Employment

	Jobs		Income	
Sector	Direct	Induced	Direct	Induced
Logging	1.0	0.510	0.568	0.510
Pulp	1.0	0.397	0.468	0.397
Lumber, Plywood, Newsprint	1.0	0.377	0.450	0.377

Table 13
Adjustment Factors for the Estimation of Short-term Indirect and Induced Impacts Resulting From Changes in Forest Sector Expenditures

	Jobs			Income		
	Indirect Fibre Hauling	Indirect Other	Induced	Indirect Fibre Hauling	Indirect Other	Induced
All Forest Sectors	1.0	1.0	0.377	0.450	0.450	0.377

Example Application:

The application of Tables 12 and 13 is demonstrated below using the coast logging example from Chapter IV.2. The long-term impacts were calculated in this example using the tables in Chapter III. Those impacts are displayed below. Equation 1 is used in the calculation of short-term employment impacts. The same procedure can be applied by the economist to derive estimates of short-term impacts on income.

	Long-term	Adjustment Factor	Short-term
Logging Impacts:			
Direct	45.0	1.0	45.0
Induced	21.4	0.510	10.9
Non-fibre Purchases:			
Indirect	19.0	1.0	19.0
Induced	6.0	0.377	2.3
Total Employment Impact	91.4		77.2

V.3 Other Impacts

In addition to the partly off-setting effects in the short-term due to UI payments, there are other mitigating effects that may take place. These include:

- compensation and pension benefits;
- early retirement packages;
- use of personal savings;
- degree of labour mobility;
- retraining programs;
- social assistance programs; and
- other government, community or industry sponsored programs (e.g. Forest Renewal).

These other potential sources of income will serve to reduce the negative induced impacts since any affected people will continue to buy groceries, pay rent and contribute to the provincial economy through their expenditures.

Although the estimation of the net effects of these various options and programs are especially important to the local area, the lack of relevant data concerning the extent and degree of use makes it difficult to accurately assess the impacts.

Another issue which has not been analyzed in this report is the impact of forest sector activities on government finances. The forest industry's total tax contribution and the impacts associated with government's spending of those tax revenues are important.

The main difficulty in estimating government revenue and expenditure effects is predicting government's reaction. For instance, the timing and size of the direct impacts are crucial in determining how government may respond. Compared to the business sector, the government sector has a greater variety of fiscal, monetary and

policy options available to use. Government also needs to consider much broader issues concerning the economic, environmental and social health and welfare of B.C. citizens and the province. Given this greater flexibility and mandate, standard model assumptions regarding linearity are not valid for the government sector, particularly in the short to medium term.

It is beyond the purpose and scope of this paper to attempt to evaluate the net effects of any other mitigating effects or consider the many possible avenues that government may choose to adopt.

VI. CONCLUDING REMARKS

VI.1 Summary

This report has attempted to provide a procedure for estimating provincial economic impacts caused by changes in forest sector activity. It has done this by focusing attention on forest sector expenditures, and then using the B.C. Input-Output Model to estimate the employment and incomes outside the forest sector which can be expected to result from these expenditures.

Based on our observations of the diversity and changing characteristics of forest sector activity, both over time and across geographical regions, we believe that a single provincial multiplier may not be appropriate for each situation analyzed. Nevertheless, we have examined enough individual cases to indicate that the ratio of total employment to direct forest industry employment falls typically within the range 2.1-2.4. However, a larger range of multiplier values are possible when specific sectors of the forest industry are analysed separately.

Estimates provided in this report are based on historical information and do not take into account changes which may result from recent policy changes such as the Forest Practices Code and the Forest Renewal Strategy. The flexibility of the procedure presented in this report should make incorporating these effects into economic analyses easier than a simple multiplier would.

VI.2 The Literature

The values estimated in this study are somewhat lower than some that have been proposed in other studies. Our sense of the impacts of the forest sector on the economy of British Columbia differ from earlier estimates partly because we have more and better information about the economy and the linkages between industries, partly because the industry itself has changed in response to the pressures of global competition for its products, and partly because the economy as a whole has changed and the effects of higher productivity, automation, etc., in industries supporting the forest sector have been observed. The findings of this report also tend to differ from more recent estimates of forest sector impacts.

However, these discrepancies exist partly because the assumptions applied to model the industry differ between studies, and partly because of differences in the intended application of the estimates. To help clarify our perception of the size of forest sector impacts, the values derived in this study are compared to some other estimates.

First, the pioneering work of Les Reed proposed a forest industry multiplier of 3.0 in the early 1970s. However, there are many reasons to believe that his estimate does not reflect accurately the impact of changes in forest sector activity today. A few of these reasons are as follows:

1. The scope of Reed's study did not permit a precise assessment of the size of the forest sector's induced employment. Reed speculated that every direct or indirect job induced one additional job. Technology available today, namely the BCIOM, enables a more accurate estimation of the linkages between sectors in the economy. Our analysis of the forest industry in 1992 indicates that 2.7 direct or indirect jobs are required to induce an additional job. This discussion indicates specifically only one of a number of differences between our estimate of the size of forest sector impacts and that estimated by Reed. Nonetheless, by updating Reed's multiplier in light of this new information it is discovered that his value falls within the range specified in our report.

2. Reed's analysis of the industry's indirect impact includes the B.C. Forest Service. However, it is argued in our report that employment attributed to the Forest Service is not related to the amount of timber cut. An additional adjustment to Reed's employment multiplier, which omits this component, would reduce his estimated value further.

3. Reed's perception of the distribution of the indirect impacts of the forest sector differs significantly from the estimates derived using the BCIOM. These differences are explained partly by differences in methodologies, but they also suggest that Reed's model does not portray accurately the current operation of the forest sector.

Next, our own 1991 report on the provincial economic impacts of a supply reduction in the B.C. forest sector (SRP) did not explicitly present forest sector multipliers[12]. However, it should be noted that the premises of this report differ from that one in a number of important ways:

1. In SRP, we utilized the 1984 Input-Output database to provide results for 1984 and then adjusted the results to reflect the 1989 economy. Here, we have

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[12] Garry Horne, Nick Paul, and David Riley, Ministry of Finance and Corporate Relations, ***The Provincial Economic Impacts of a Supply Reduction in the British Columbia Forest Sector***, prepared for the B.C. Forest Resources Commission, February, 1991.

chosen to make simple adjustments so that employment is appropriate for 1992, but in treating the components of the forest sector expenditures separately, we make the assumption that the linkages relating to those expenditures are as they were in 1984.

2. In SRP, we used a balanced version of the BCIOM model which effectively assumes that all employment income is spent on personal goods and services. In fact, of course, approximately 25% of employment income is taken by income taxes and savings so that only 75% is re-spent in the domestic economy leading to induced spin-off activity. The latter assumption has been made in this report.

3. In the period since the SRP, we have had occasion to review our estimates of employment associated with the distribution of final products from the forest sector (what was called transportation/wholesale activity in SRP). Based on more recent information from Statistics Canada regarding transportation and wholesale trade margins for forest products, we believe that the estimates given in this report are a more accurate reflection of the extent of these activities than those of the earlier report.

Finally, in a recent study, David Park (1994) used the 1984 BCIOM to estimate the overall impact on British Columbia and Metropolitan Vancouver attributed to the forest industry in the province[13]. Although both Park's and our own analysis used the same model to identify the linkages between industry sectors in the economy, there are significant differences in the results. In part, this is because the two studies have different objectives. Park's 1994 paper applied the BCIOM to estimate the total economic impact of the forest industry on the province in the year 1993. On the other hand, this report uses the same model to measure the impact of changes in forest sector activity. The two perspectives do not necessarily produce similar economic ratios. Specifically, the papers differ with respect to the treatment of industry taxes, the re-spending of tax revenues, and investment.

1. Park incorporated the forest industry's direct payments to government and tax payments resulting from respending of the taxes collected as a component of the industry. Although the forest sector's total tax payments are significant, the impact of a proposed change in annual allowable cut on government revenue and spending is likely to be insignificant. Therefore, those impacts are not included in this study.

2. Park's results for B.C., excluding the impact of the forest sector on government finances, indicate an employment multiplier of 2.79 and an income multiplier of 2.04. However, Park also included the impacts associated with industry investment in his analysis. As a result, the multipliers derived from his study

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[13] Park, D. *The Economic Impact of the Forest Industry on British Columbia and Metropolitan Vancouver*. Prepared for the Forest Alliance of British Columbia, 1994.

incorporate those impacts. Our paper acknowledges the importance of forest sector investment to total provincial economic activity. However, investment activities are treated separately in our analysis. Although there is nothing implicitly wrong with Park's multipliers, an economist adopting them must be aware of what exactly they are intended to measure. Park's multipliers (excluding impacts on government finances) can be applied appropriately to assess large, or industry-wide, shocks to the forest sector. On the other hand, small shocks to the industry are not likely to alter investment levels, and therefore his estimates will tend to overstate the impact of those shocks and shocks that affect only some forest activities.

In conclusion, adopting forest sector multipliers based on the industry's "general rule of thumb" will not produce the best estimate of a proposed change in every situation. The findings of this study suggest that "off the shelf" multipliers will likely overstate the economic impact of an exogenous shock to the forest sector. The economic ratios suggested in this report may be lower than proposed in other studies. Nonetheless this report provides reasonable estimates of the impacts identified with policy or market induced changes in forest sector activity.

VI.3 What About Other Years?

The coefficients presented in Chapter III are expressed in terms of 1992 dollars and 1992 employment. The 1992 constant dollar expenditures, were derived from Price Waterhouse current dollar expenditures for 1989 to 1993 by using the B.C. Consumer Price Index as a deflator.

If the economist can estimate forest sector expenditures in the current year or future years for fibre purchases, non-fibre purchases, sales of final products or wages, he/she should deflate these expenditures to represent 1992 constant dollars before applying the coefficients presented in this chapter. The reason deflation is necessary is that a million dollar expenditure in 1996, for example, will purchase less goods and services or employment, hence generate less economic activity and therefore create fewer jobs than a million dollar expenditure in 1992.

Alternatively, if the economist cannot estimate forest sector expenditures, there is the option of using the coefficients in Table 1 to estimate changes in forest sector expenditures ($1992) per thousand cubic metres. Using the estimates in Table 1 without adjustment for years other than 1992 makes the implicit assumption that inflation affects all relevant price and wage levels by the same amount.

VI.4 Revised Input-Output Tables

The estimates of indirect and induced economic activity have been estimated using the 1984 BCIOM, adjusted to reflect 1992 employment. That is, the inter-industry expenditure leakages for the non-forestry sectors are based on 1984 averages.

Provincial and territorial Input-Output data are estimated periodically (once every five or six years) by Statistics Canada. The next release of sub-national Input-Output Tables is for the year 1990.

Changes which have taken place in the B.C. economy between 1984 and 1990 will result in new estimates of expenditure, employment and income coefficients from those presented in this paper. For example, different estimates could arise due to price effects, changes in industry productivity, or the emergence of industrial activity for the domestic production of goods and services that were previously imported. We expect to update this report once the 1990 BCIOM is fully operational, probably in the late Spring of 1996.

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Appendix A
Inappropriate Application of Multipliers

Economic impact multipliers are designed to fit the requirements of a particular case. One reason why no "all purpose" provincial level forest sector multiplier is recommended is that provincial level impacts of a given change may differ for the same harvesting activities, if the harvesting activities occur in different regions. There are several reasons for this. Firstly, logging practices (and hence labour and capital requirements) will vary depending on the local topography, climate, and the age and type of trees being harvested. As well, logging practices may be regulated by special restrictions designed to protect certain ecosystems. Secondly, the forest sector includes a wide range of enterprises, from those engaged in logging to those making value-added products like kitchen cabinets. The labour requirements of each of these types of activities will differ. Therefore, the employment impacts will depend on the relative importance of the different components of the forest industry within the particular regions affected by a direct change.[14]

Notwithstanding the variability of the total number of jobs impacted by the forest sector on an aggregate basis, a more significant issue arises when examining individual situations. Increases or reductions in forest activity may not lead to industry responses that are consistent with the province-wide average, and therefore applying a "multiplier" estimated from aggregate, province-wide activities will not be valid. For example, after a reduction in a region's harvest levels, wood manufacturers may still be able to import fibre. In this case, harvest reductions would only impact logging operations, so a province-wide multiplier would likely overstate the employment loss. The extent of automation also varies between companies and between regions. If highly automated manufacturers start up or shut down, the direct employment, and hence the induced effects will be smaller than would be indicated by a multiplier based on a provincial average.

Related to this is the problem of nonlinear threshold effects. Input-output models like the British Columbia Input-Output Model (BCIOM) assume that firms can perfectly adjust to market changes by changing output levels. Actual individual firm behaviour may be quite different, depending on the firm's current level of production and financial commitments and whether the firm views a change as being temporary or permanent. For example, if fibre supply declines in an area, then at some point (the threshold level of production) a mill will shut down because of the reduced log supply, rather than just reducing production and laying off a proportionate number of workers.

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[14] Over the period 1986-90 the average number of direct jobs per 1,000 cubic meters of timber harvested was 0.63 in the Interior region and 1.32 in the Coast region. Economics and Trade Branch, Ministry of Forests, *The Economic Impacts of Timber Harvesting in British Columbia*, October 1993.

A further problem arises if the activities selected as "direct" for analysis purposes differ from those used in the aggregate multiplier. For example, if log transportation was included as indirect in the provincial aggregate multiplier, but treated as direct in the analysis, the total impacts would be overstated. For the results of different studies to be comparable the definition of the direct forest sector needs to be consistent from analysis to analysis. The problem with the use of "off the shelf" multipliers is the tendency to apply such multipliers to a different direct forest sector than that intended when the multiplier was originally calculated.

Appendix B
Definition of the Forest Sector - The Direct Impact

The total employment impact of a change in the forest sector (e.g. a decrease in harvest levels) can be conceptualized as consisting of a direct change in jobs in the forest sector itself, employment changes in industries that provide goods and services to the forest sector (indirect impact), and employment changes caused by changes in consumer spending of directly or indirectly employed forestry workers (induced impact).

A crucial step in estimating employment impacts is a clear definition of the industries which will be included as part of the forest sector, so that direct forest sector employment can be calculated and indirect impacts estimated. The forest sector is comprised of those industries that process products containing a significant amount of wood or wood fibre. Using Statistics Canada's 1980 Standard Industrial Classification (SIC) system, enterprises which are classified into one of the following 29 industrial classes shown in the table below would generally be considered part of the forest sector. [15]

Table B1
Forest Sector Industries
(continued on the following page)

Major Group	Industry Group	Industry Class
04 Logging	041 Logging	0411 Logging
05 Forestry Services	051 Forestry Services	0511 Forestry Services
25 Wood	251 Sawmill, Planing Mill, and Shingle Mill Products	2511 Shingle and Shake Mill Products 2512 Sawmill and Planing Mill Products
	252 Veneer and Plywood	2521 Hardwood Veneer and Plywood 2522 Softwood Veneer and Plywood
	254 Sash, Door and Other Millwork	2541 Prefabricated Wooden Buildings 2542 Wooden Kitchen Cabinet and Bathroom Vanity 2543 Wooden Door and Window 2549 Other Millwork
	256 Wooden Box and Pallet	2561 Wooden Box and Pallet
	258 Coffin and Casket	2581 Coffin and Casket
	259 Other Wood Industries	2591 Wood Preservation 2592 Particle Board 2593 Wafer Board 2599 Other Wood

[15] James Dobie, FRDA Report 191: *Estimating Forest Sector Employment in British Columbia*, Forestry Canada and the British Columbia Ministry of Forests, September 1992, p. 3.

Table B1 (continued) Forest Sector Industries		
27 Paper and Allied Products	271 Pulp and Paper	2711 Pulp 2712 Newsprint 2713 Paperboard 2714 Building Board 2719 Other Paper
	272 Asphalt Roofing	2721 Asphalt Roofing
	273 Paper Box and Bag	2731 Folding Carton and Set-up Box 2732 Corrugated Box 2733 Paper Bag
	279 Other Converted Paper Products	2791 Coated and Treated Paper 2792 Stationery Paper Products 2793 Paper Consumer Products 2799 Other Converted Paper Products

However, even this definition of the forest sector presents some problems. Some (unknown) amount of transportation and wholesaling activity is embedded within the employment and output statistics reported for these industries, even though transportation and wholesaling would generally be considered activities indirectly supporting the forest sector and not part of the sector itself. Consider, for example, a vertically integrated company which transports logs to its sawmill using its own trucks and also sells raw logs through wholesale log brokers employed by the company. Sawmilling accounts for the major portion of company revenue. If statistics like number of employees, salaries and wages, and value of shipments for the transportation of logs and the wholesaling activities are not separately identifiable from the sawmilling activity, the total activity of the company would be allocated to the sawmill and planing mill industry. However, if the sawmill paid a trucking company to transport logs to its mill then that transportation activity and employment would be allocated to the transportation sector, and not included in forest industry statistics. So, contract log trucking companies in the Interior and the Coast, as well as contract marine log barge companies on the Coast, are omitted from logging statistics. Similarly, an independent wholesaler of forest products would be included in wholesale trade statistics, not the forest sector.

Why is this a problem? Consider the results that would be obtained if an economist calculates a multiplier assuming that transportation of forest products is an indirect activity, and then someone else applies that multiplier to a direct employment estimate that includes forest products transportation activities. This would lead to an incorrect double counting of the transportation impacts.

Some other industries which may include a forest industry component, depending on whether changes in transportation and wholesaling are considered direct or indirect impacts, are listed in the table below.

Table B2 Related Industries		
Major Group	Industry Group	Industry Class
45 Transportation Industries	453 Railway Transportation and Related Services	4531 Railway Transport Industry
	454 Water Transportation Industries	4543 Marine Towing Industry
	456 Truck Transport Industries	4565 Forest Products Trucking Industry
56 Metals, Hardware, Plumbing, Heating and Building Materials Industries, Wholesale	563 Lumber and Building Materials, Wholesale	5631 Lumber, Plywood and Millwork, Wholesale
59 Other Products Industries, Wholesale	592 Paper and Paper Products, Wholesale	5921 Newsprint, Wholesale 5929 Other Paper and Paper Products, Wholesale
	599 Other Products, n.e.c, Wholesale	5993 Forest Products, Wholesale

There is also a need to clarify whether or not forestry services should be included as part of the forest sector. Forestry services include forestry patrol, fire inspection and fire fighting, forest nurseries, and reforestation activities. When multipliers are created the linkages between industries are important. However, the size of the public Forest Service is generally independent of the extent of activity in the forest sector. Rather, the size of the Forest Service is more likely to depend on the requirements for the enforcement of forestry regulations as set out in legislation and the priority given by the government of the day to the enforcement of those regulations.

A similar issue is whether capital investment by the forest industry (e.g. investing in new pulp mill equipment to meet new environmental regulations) should be included as direct expenditure by the forest industry for economic impact estimation purposes. The argument for omitting these expenditures is that, over the near term, capital investments may not be directly tied to the extent of fibre extraction and processing activities. Rather, capital investment may be influenced by other factors like competition, interest rates, and government environmental and forest practice regulations. This study has taken this view.

Appendix C
Economic Impact Analysis and the Input-Output Model

1. The BCIOM

Input/output analysis is based on detailed statistical information in the form of mathematical matrices which portray the flow of goods and services between the various sectors of the economy. These matrices provide a comprehensive and detailed representation of the economy for a particular year.

The British Columbia Input-Output Model (BCIOM) is derived from the 1984 Interprovincial Input-Output Model developed by Statistics Canada. The BCIOM is an extensive database, consisting of 602 commodity, 216 industry and 136 final demand accounts, and a set of computer algorithms to make the calculations required for the solution of the model. The database consists of the following three matrices:

(1) The input matrix, which records the commodity inputs required (demanded) by each producing industry;

(2) The output matrix, which records the commodities produced (supplied) by each domestic industry; and

(3) The final demand matrix, which shows the disposition of the available supply of goods and services to various final users (personal expenditure, investment, government expenditure and exports). This represents the demand for goods and services that are not used as intermediate inputs in the production of other goods and services. The final demand matrix also records the estimates of imports and government production, which represent the remaining supply of goods and services, not made by the domestic producing sectors.

The BCIOM, like all other input/output models, is an intersectoral model which assumes that consumption is the purpose of all production activities. It is designed to estimate the domestic production efforts required to meet a given level of demand. In other words, the BCIOM is demand-driven.

2. Estimates Generated by the BCIOM

By specifying a change in demand for one or more of the BCIOM industries or commodities and simultaneously solving for all relationships, the model can estimate the total impact on all industrial sectors of the economy. The total impact of an initial change in demand is broken down into three separate effects. These are the direct, indirect and induced impacts.

Direct Impact

The direct (final demand) impact measures the change in domestic output required to satisfy the initial change in demand.

Indirect Impact

In order to increase its output, an industry must purchase goods and services inputs (intermediate inputs) from other sectors. This demand for intermediate goods and services stimulates additional production activity in other sectors of the economy. In turn, the sectors that produce these intermediate goods and services require other intermediate inputs and so forth. The increased domestic output that satisfies the cumulative demand for all of the intermediate goods and services is called the indirect impact.

Induced Impact

The various sectors which increase their output to satisfy either final demand (direct) or intermediate demand (indirect) must hire labour to produce their goods and services. The income that is paid to these workers does not remain idle, but is spent on a myriad of consumer goods and services. This demand generates another round of production activity, which in turn, stimulates further economic activity (additional production activity and more labour income). The increased domestic output due to workers spending their income is called the induced impact.

The model traces the spin-off effects of industrial and personal consumption demand and estimates B.C. industrial output (shipments or gross sales), Gross Domestic Product (GDP), labour income, and employment impacts.

3. Assumptions and Caveats

- The BCIOM is a linear model of economic relationships. This implies that there are no supply constraints for materials or services (including labour), no relative price changes, no substitution effects and no economies of scale.

- The assumption of linearity also implies that industrial production is based on a constant market share principle.

- The BCIOM is a static model. That is, time is not explicitly represented in the BCIOM. Therefore, the model estimates the propagation of demand between the various sectors of the economy but it does not reflect the timing of the various effects.

- The present model is based on data representing the economy of British Columbia for the year 1984. However, since the technical relationships

between industries tend to change slowly, the estimated impacts are assumed to remain valid for subsequent years.

- The BCIOM assumes there are no capacity constraints for any increased production. That is, investment in new plant or machinery and equipment is not explicitly modelled. The economist must estimate any new investment in construction activity or machinery and equipment acquisition separately. The model can then be used to estimate the effects of these increased capital expenditures.

- Estimates generated by the BCIOM represent medium-term provincial averages. It is not appropriate to apply the results from the BCIOM for smaller regional studies. In general, a sub-provincial area will have more leakages from its economy than the entire province. This occurs because a region with less diverse industrial activity will tend to import more goods and services. This will result in smaller impacts in a region than the province as a whole.

- It is also not appropriate to attempt to use the results to estimate short-term marginal impacts. The technical relationships in the BCIOM are based on average industrial use, average import content, and average personal consumption that are assumed to occur over the long term.

- The BCIOM assumes that all sectors in the economy are operating at full capacity with respect to employment. Therefore, any increase in industrial output requires a proportional demand for new labour services. This assumption implies that employment levels must necessarily increase to produce the increased industrial output.

- The induced impacts represent the spin-off activity due to wage earners spending their income on consumer goods and services. For this study, we assumed that 75 per cent of personal income (net of benefits or supplementary labour income) is spent in this manner. The remaining 25 per cent of personal income represents personal income taxes, savings and expenditures outside of B.C. This percentage is based on the average (1983 to 1992) ratio of expenditure to total income less supplementary labour income, from the British Columbia Economic Accounts.

- The BCIOM measures the change in economic activity due to a demand stimulus. Therefore, any additional wages paid to "new labour" should be adjusted downward by the amount of social assistance (U.I.C. or welfare) that they previously received.

- The BCIOM does not explicitly evaluate the financing options of project proposals. For example, any economic impact study concerning public or quasi-public projects requires consideration as to the source of funds

necessary to finance the venture. Any increase in government taxes or fees to help finance a project may have the effect of dampening the total impacts.

- Estimated impacts generated by the BCIOM should not be viewed as a cost-benefit analysis or a multiple-accounts analysis study. Externalities such as pollution or other social and environmental costs and benefits are generally not included in an input/output analysis. The BCIOM also does not consider alternative uses of the direct expenditures.

The model is maintained by the Analysis and Evaluation Branch of Treasury Board Staff in the Ministry of Finance and Corporate Relations. Access to the detailed database is limited to branch staff under the data exchange protocol with Statistics Canada.

Appendix D
Impact Estimation Procedure Summarized in "Spread Sheet" Mode

The procedures developed and described in detail in Chapter III of this report can be summarized succinctly in the tables presented in this Appendix.

Step 1

The economist fills in the values required in Table D1, using the best sources of information relevant to the situation under study

Table D1
Data Input Requirements (1992 $ Millions)

		A	B	C	D
		Wages	Fibre Purchases	Non-Fibre Purchases	Sales
1	Logging & Forestry	A1	---	C1	---
2	Lumber & Remanufacturing	A2	B2	C2	D2
3	Plywood & Veneer	A3	B3	C3	D3
4	Pulp	A4	B4	C4	D4
5	Newsprint & Paper	A5	B5	C5	D5

Step 2

The economist calculates the employment and wage impacts suggested in Tables D2 and D3, respectively.

Table D2
Calculations for Employment Impacts

		Induced by Forest Wages	Hauling		Non fibre purchases		Product Distribution	
			Indirect	Induced	Indirect	Induced	Indirect	Induced
1	Logging & Forestry	9.09*A1	0	0	8.17*C1	2.57*C1	0	0
2	Lumber & Remanufacturing	9.09*A2	0.47*B2	0.16*B2	7.09*C2	1.97*C2	2.03*D2	0.74*D2
3	Plywood	9.09*A3	0.56*B3	0.19*B3	6.12 *C3	1.80*C3	1.61*D3	0.58*D3
4	Pulp	9.09*A4	0.94*B4	0.31*B4	5.80*C4	1.72*C4	0.76*D4	0.27*D4
5	Newsprint	9.09*A5	0.72*B5	0.27*B5	4.84*C5	1.46*C5	0.61*D5	0.29*D5

Table D3
Calculations for Wage Impacts (1992 $ Millions)

		Induced by Forest Wages	Hauling		Non fibre purchases		Product Distribution	
			Indirect	Induced	Indirect	Induced	Indirect	Induced
1	Logging & Forestry	0.236*A1	0	0	0.263*C1	0.067*C1	0	0
2	Lumber & Remanufacturing	0.236*A2	0.017*B2	0.004*B2	0.217*C2	0.051*C2	0.062*D2	0.019*D2
3	Plywood	0.236*A3	0.021*B3	0.005*B3	0.198*C3	0.047*C3	0.064*D3	0.015*D3
4	Pulp	0.236*A4	0.034*B4	0.008*B4	0.189*C4	0.045*C4	0.031*D4	0.007*D4
5	Newsprint	0.236*A5	0.029*B5	0.007*B5	0.161*C5	0.038*C5	0.033*D5	0.008*D5